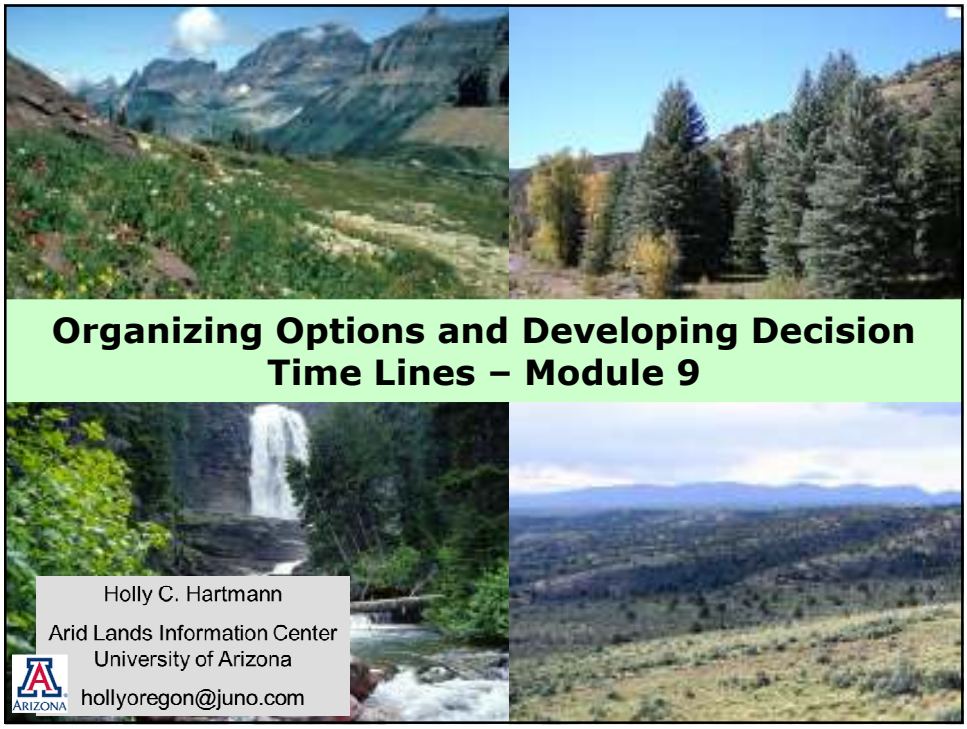

Organizing Options and Developing Decision Time Lines – Module 9

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Phases in Scenario Planning

I. Preparing for the process
II. Building and refining scenarios
III. Using scenarios to evaluate, prioritize, and implement management actions

So What?

1: Just Let It Go /Habooby Trap
[HI DISTURBANCE – LO VALUES /
HI SUMMER WINDS - DRY WINTER]

Winds, flood, fires, and humans damage physical remains but the public is willing to let these go because they have other concerns.

2: Nothing Happens but Nobody Cares / Tucson Good Ol' Days
[LO DISTURBANCE – LO VALUES /
EARLY MONSOON – DEC TROPICAL CYCLONES]

A lengthened dry season followed by energetic monsoon damages physical remains; loss is compounded if the public doesn't connect and engage.

3: All Hands on the Land! /No Analog
[HI DISTURBANCE – HI VALUES /
LATE MONSOON – INC TROPICAL CYCLONES]

The most damaging to physical remains, but public engagement is high in appreciation, involvement, funding, and hands-on stewardship.

Use of Scenario Narratives

- Insight! -- Outreach
- Bring insight to ongoing processes: stakeholder discussions, modeling studies, vulnerability assessments, USFS ILAP, NPS RSS, BLM REA

- Evaluate existing plans: BLM landscape plan review
- Evaluate extant adaptation options: robust, no regrets?

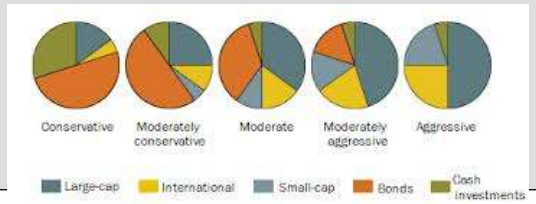
- Innovate new adaptation options: stops  , bridges
- Develop portfolios of options: time-varying, weighted

Using Scenarios

0. Vet scenarios
1. Evaluate potential impacts and implications
2. Identify potential strategies or action plans
3. Prioritize actions
    - robust actions, no regrets actions
    - contingency actions
    - bridging actions
4. Structure monitoring and research
    - decisions
    - triggers
    - scenario differences

Identify Possible Decision Strategies

- Punt!
- Delay and assess
- Commit with fallbacks
- Shape the future
- Robust: good across all scenarios
- Portfolio of options: shifting over time



Categories of Adaptation Options

1. **Resistance:** defend against change (Homeland Security)
2. **Resilience:** 'bounce back' after disturbance (Health Care)
3. **Response:** facilitate change (Beginners Mind), e.g., regional approaches, interconnections, diversity
4. **Realignment**: accept different systems, focus on function (Auto Mechanics)
5. **Reduce:** *mitigation* of GHG (Good Samaritan)
6. **Triage:** let go (Pragmatic)

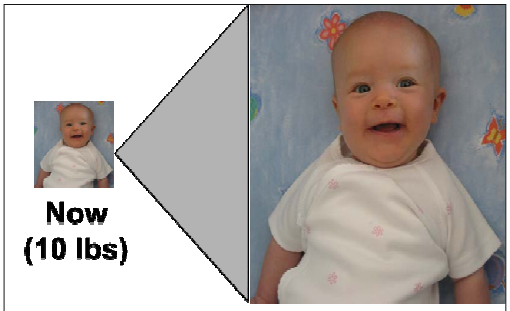
Adapted from Millar et al, 2007. Ecological Applications. 2008, Forest Guild presentation

Some things to keep in mind….

The past is never dead. It isn't even past. -- William Faulkner

The future is already here. It's just not very evenly distributed. -- William Gibson

As we know,
There are **known knowns**.
There are things we know we know.
We also know
There are **known unknowns**.
That is to say
We know there are some things
We do not know.
But there are also **unknown unknowns**,
The ones we don't know
We don't know.
—D.H. Rumsfeld, 2002



Pagano, 2008

The future is not a magnification of current challenges.

No Regrets – Different Concepts

No Regrets
- increase resilience

No Regrets
- avoid locking in vulnerabilities

No Regrets
- create benefits in the short-term
- win-win-win: benefits across many values, needs

No Regrets
- appropriate across all plausible futures

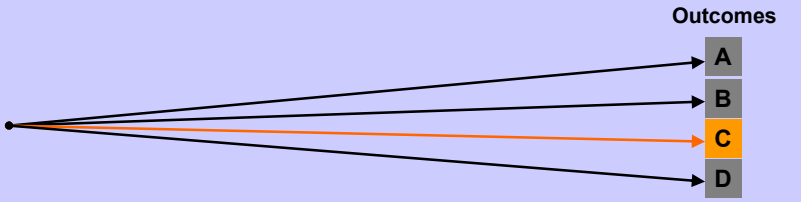
No Regrets
- portfolio of weighted investments for multiple plausible futures

Is Typical Planning Flexible Enough?

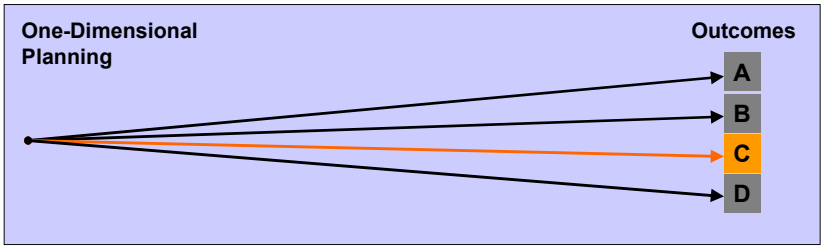
Planning for a Desired Future

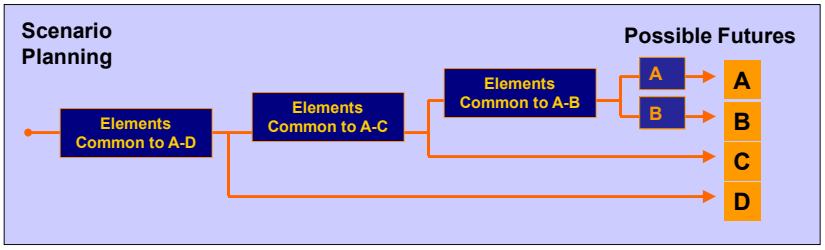
- Defining goals
- Taking stock
- Examining trends
- Setting targets, thresholds
- Directing management

Choosing Among Alternatives



One-Dimensional Planning vs. Robust Planning

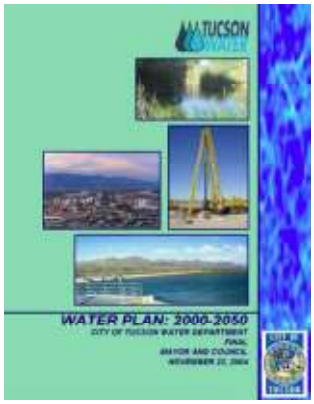


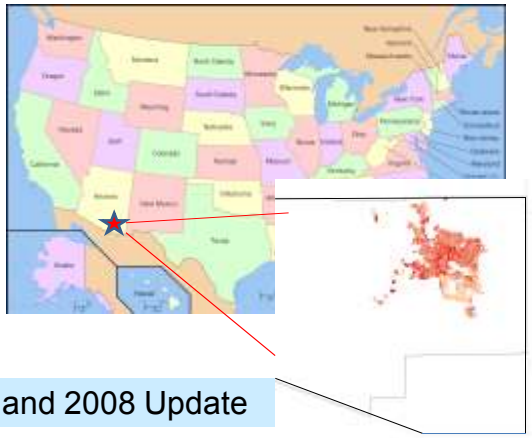


Good example: City of Tucson Water Plan: 2000-2050 Updated Version

Case Study: Tucson Water 2000-2050, 2008 Update, and Beyond

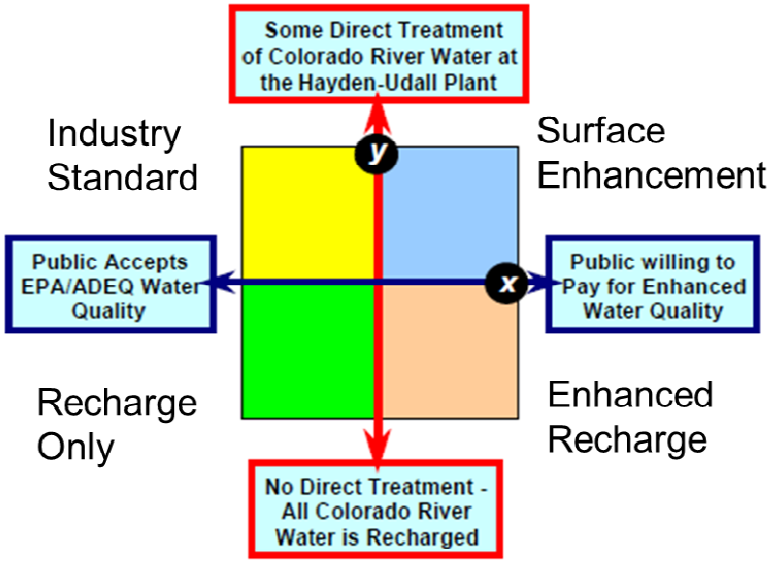
Tucson Water: 225,000 connections, 775,000 people, 350 square miles



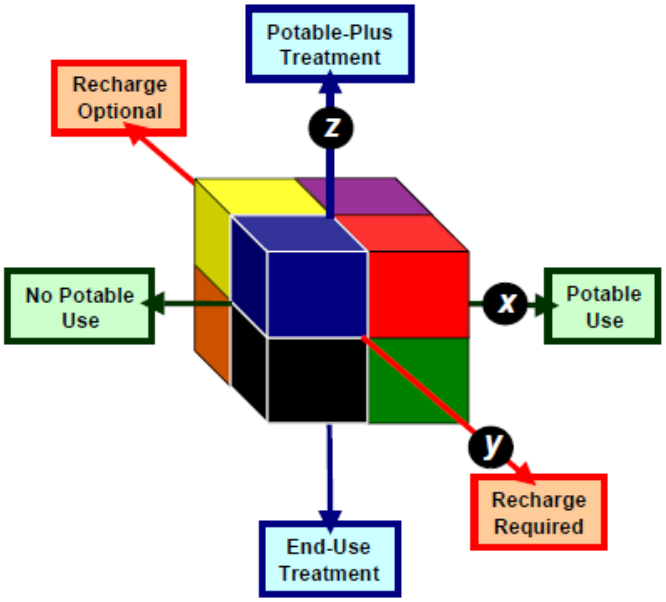


and 2008 Update

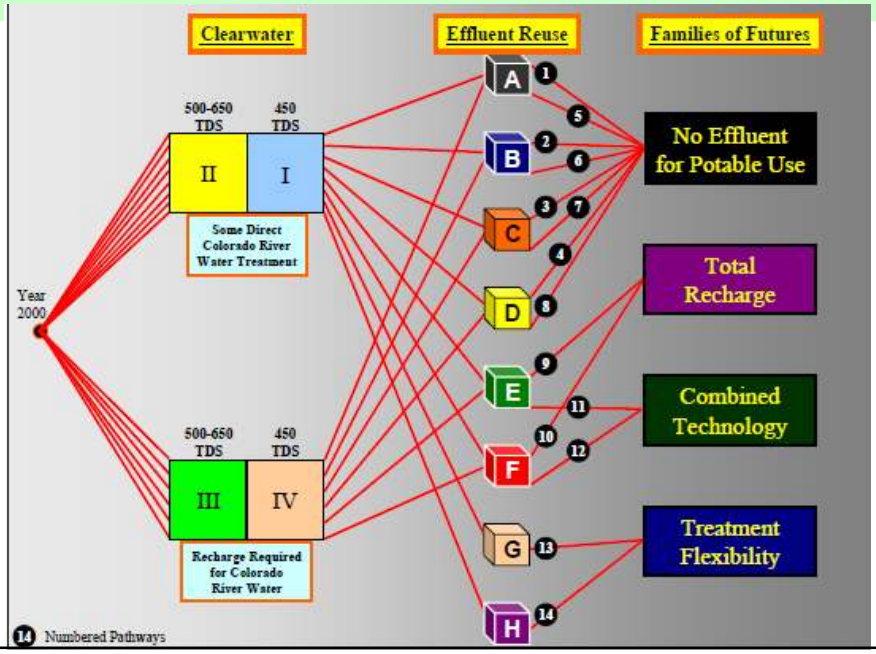
Values about Use of Colorado River Water



Values about Use of Wastewater Effluent



Combining Short- and Long-term Scenarios

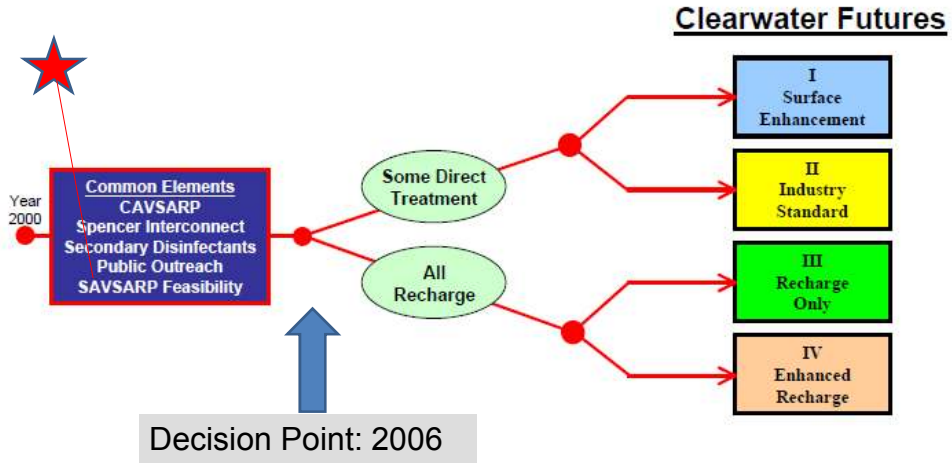


Lay Out Timelines for Each Adaptation Option

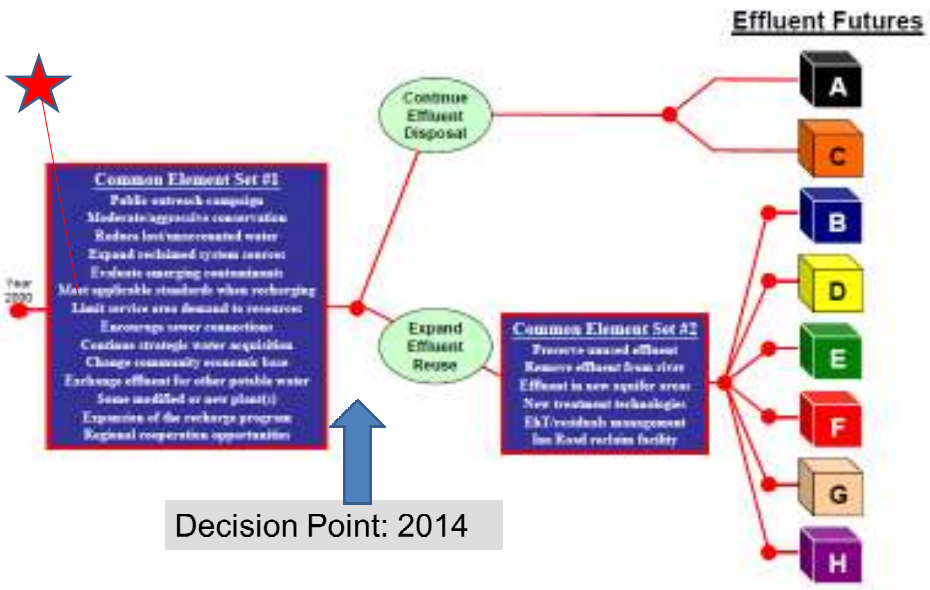
Pathway	Spencer Interconnect	Avra Valley Main Augmentation	Effluent Pipeline to Avra Valley	Effluent Pipeline to Tucson Basin	Ina Road Interconnect	Expand CAVSARP Recharge to 80k	SAVSARP Phase I	Rehabilitate Hav
	Major Pipelines					Potable System		
1	2006	2009				2005		2009
2	2006	2009	2017		2017	2005		2009

Natural resources analog for resource areas? Aquatic, terrestrial ?? Others? – facilities, visitor services

Some Options Common to All Futures: CO. R.



Options Common to All or Some Futures: Effluent



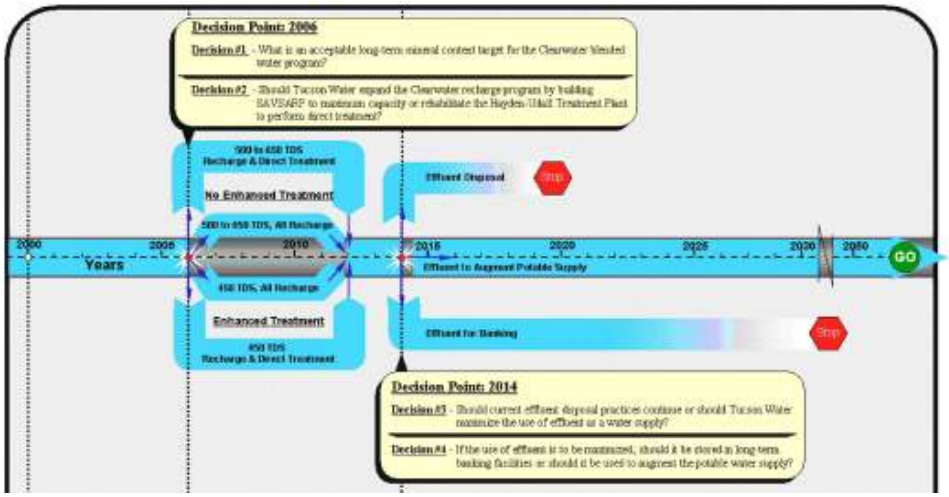
Rate Collections of Options with Evaluation Criteria

1: Using CO R water, no recharge. Not using effluent.
9: Using both CO R water and effluent, recharging both.

Pathway	Colorado River Water Source Acceptance	Effluent Water Source Acceptance	Renewable Supply Utilization	Meeting Projected Water Demand	Source Reliability	Impacts To Recharge Neighbors	Riparian Issues	Salinity Control	Subsidence Prevention	TOTAL	Clearwater F
	<<<<<Source Water>>>>>			<<Operations>>		<<<<<<<Environment>>>>>>>				Overall	
1	6	10	1	1	1	10	6	4	1	38	FAIL
9	10	5	10	10	10	1	1	7	10	64	PASS!

Natural resources analog for criteria? Biodiversity, wilderness, scenery, recreation, carbon and water storage…
Criteria for other resource areas?

Timeline of Alternative Actions and Decision Points



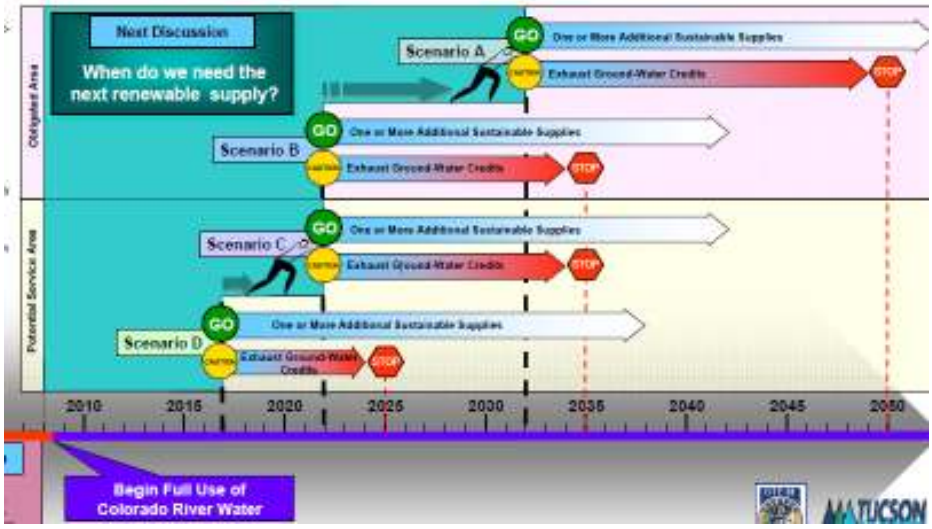
Revisiting the Scenarios in 2008

	With Additional Demand Management	Without Additional Demand Management
Obligated Area	Scenario A	Scenario B
Potential Service Area	Scenario C	Scenario D

New critical uncertainty: Water demand. City considers expanding service area.

Some uncertainties gone: Decision H2O in 2006/7. Customers OK with basic water standards

Revisiting the Scenarios in 2008: Considering Demand

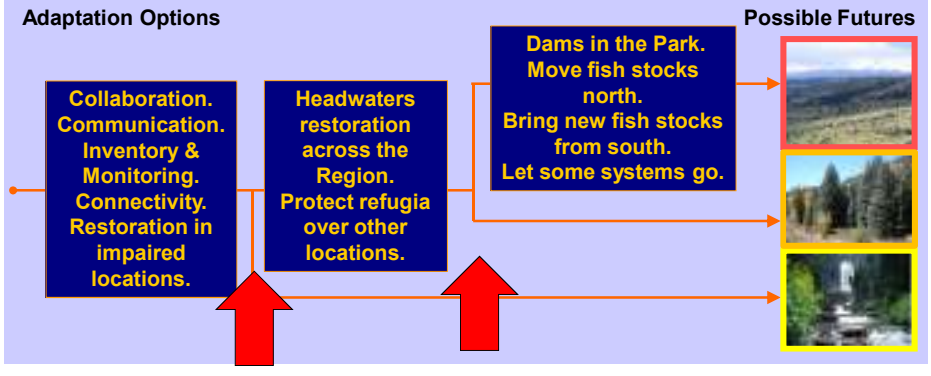


Decision Points

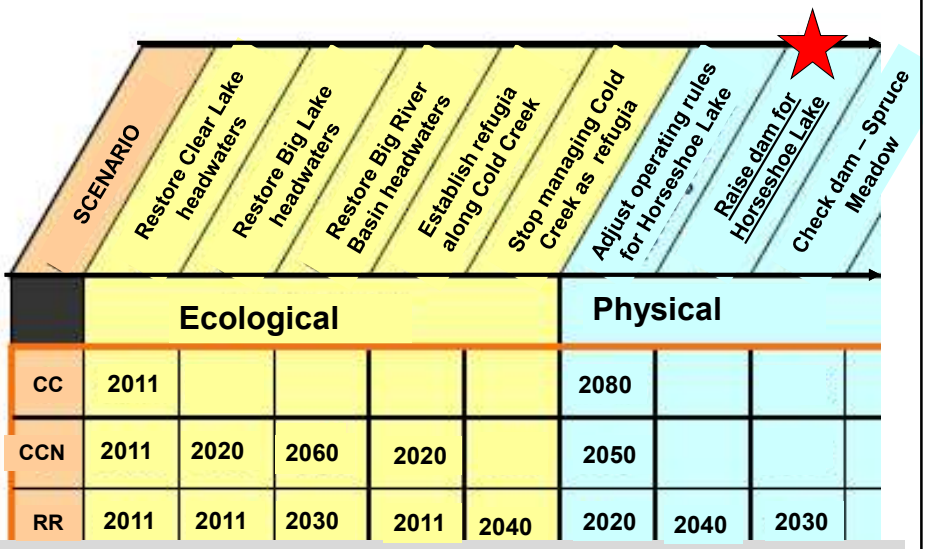
Climate Complacency: Is Anyone Out There?

Colorado Creeps North: Wheel Spinning

Race to Refuge: Big Problems, Big Solutions



Decision Points for Each Action Option



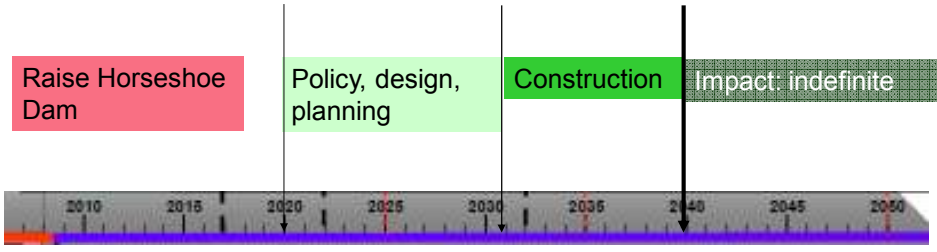
Categories: Institutional, biological, ecological, physical, geochemical

Timelines of Options

Climate Complacency: Is Anyone Out There?

Colorado Creeps North: Wheel Spinning

Race to Refuge: Big Problems, Big Solutions



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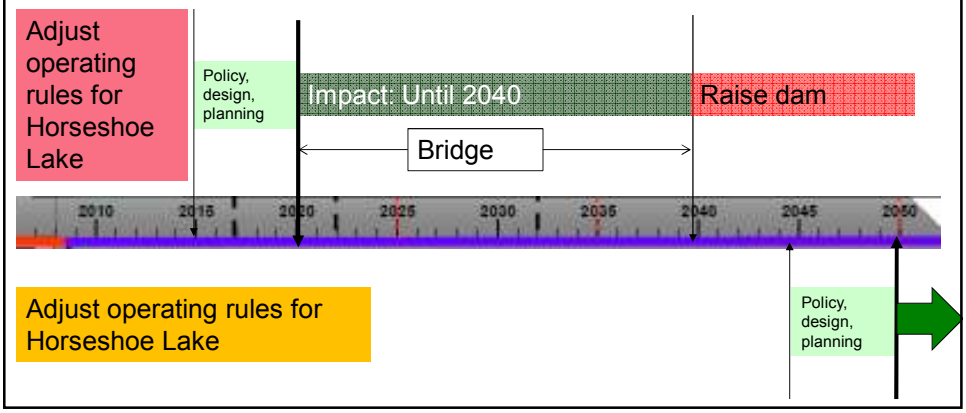
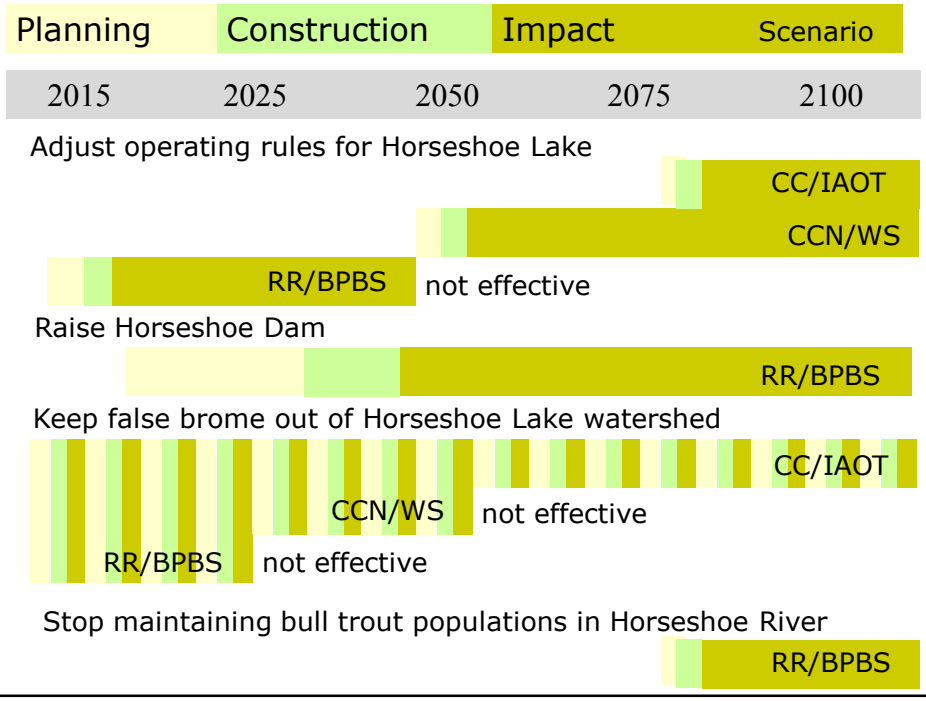
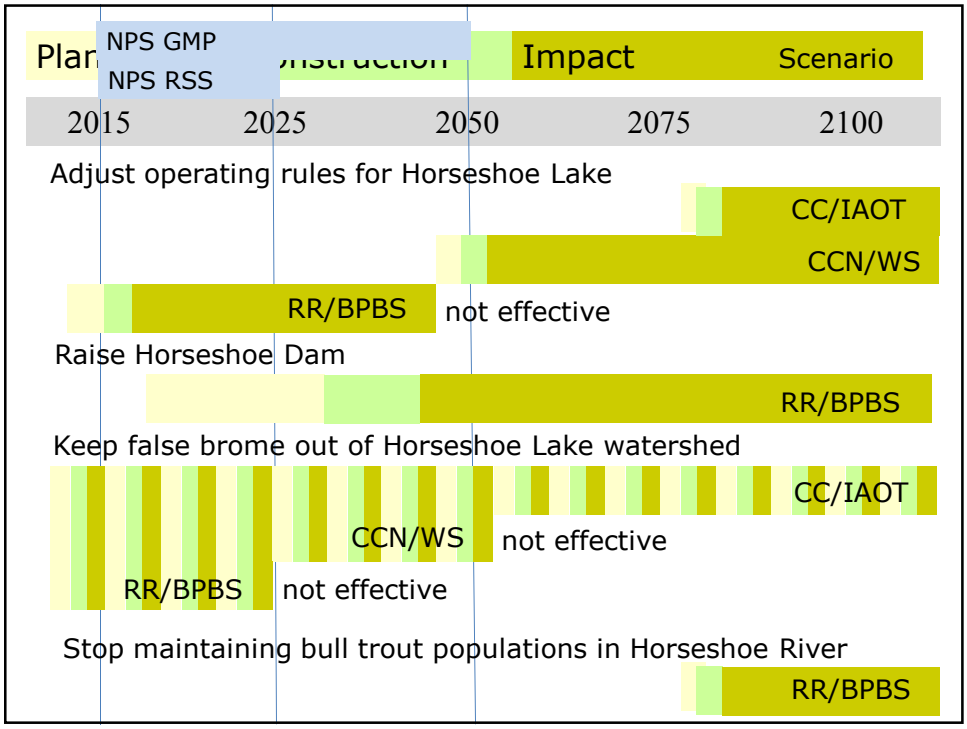
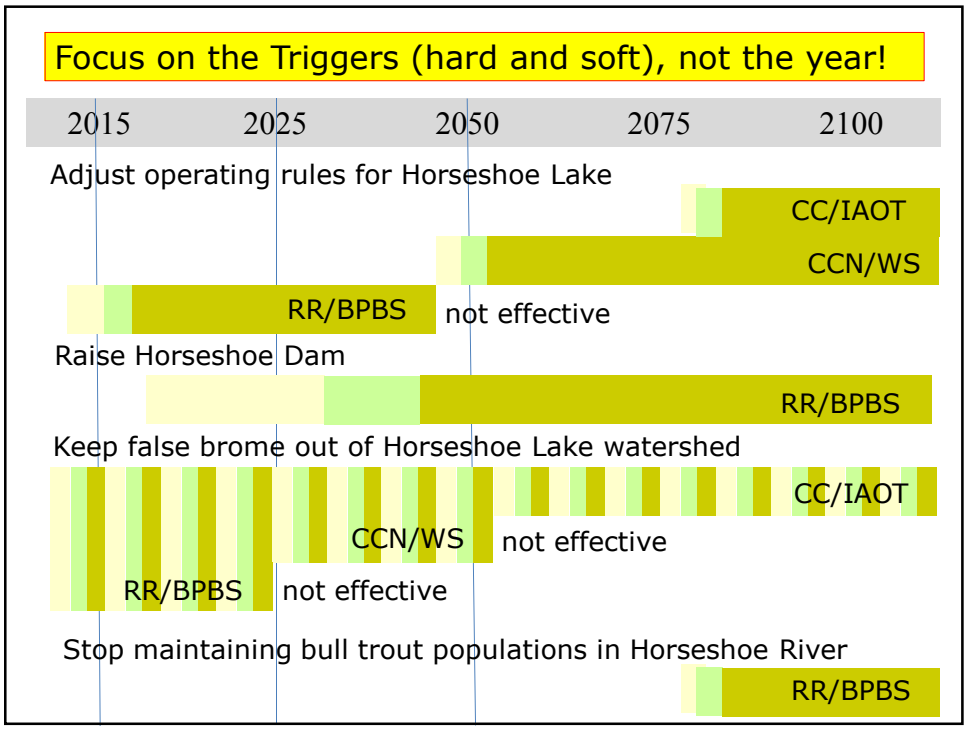





Plan
NPS GMP
NPS RSS
Impact
Scenario
2015
2025
2050
2075
2100
Adjust operating rules for Horseshoe Lake
CC/IAOT
CCN/WS
RR/BPBS
not effective
Raise Horseshoe Dam
RR/BPBS
Keep false brome out of Horseshoe Lake watershed
CC/IAOT
CCN/WS
not effective
RR/BPBS
not effective
Stop maintaining bull trout populations in Horseshoe River
RR/BPBS


Focus on the Triggers (hard and soft), not the year!
2015
2025
2050
2075
2100
Adjust operating rules for Horseshoe Lake
CC/IAOT
CCN/WS
RR/BPBS
not effective
Raise Horseshoe Dam
RR/BPBS
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Rate Collections of Options with Evaluation Criteria

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1	6	10	1	1	1	10	6	4	1	38	FAIL
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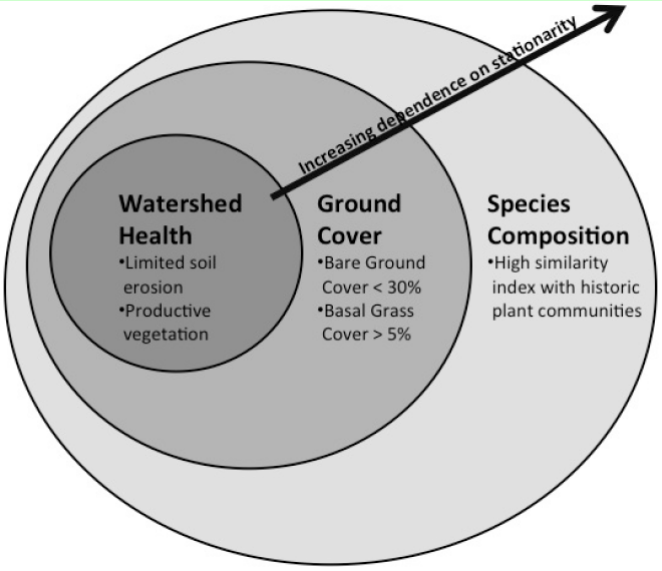
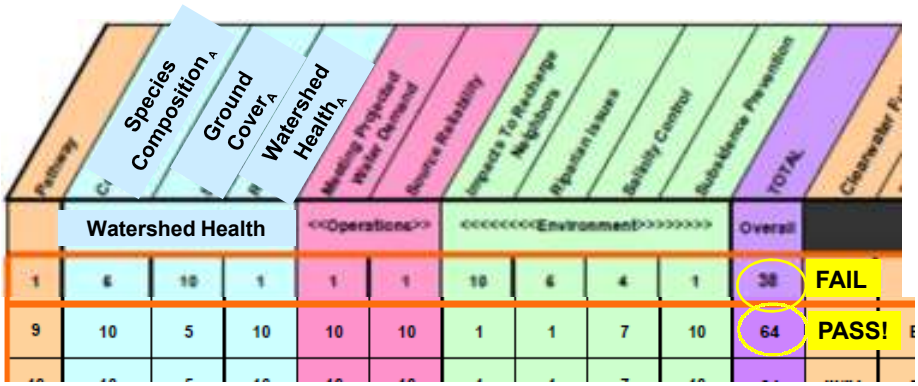
NPS Analogs? Manage for biodiversity, wilderness, scenery, recreation, carbon and water storage

Nested Objectives



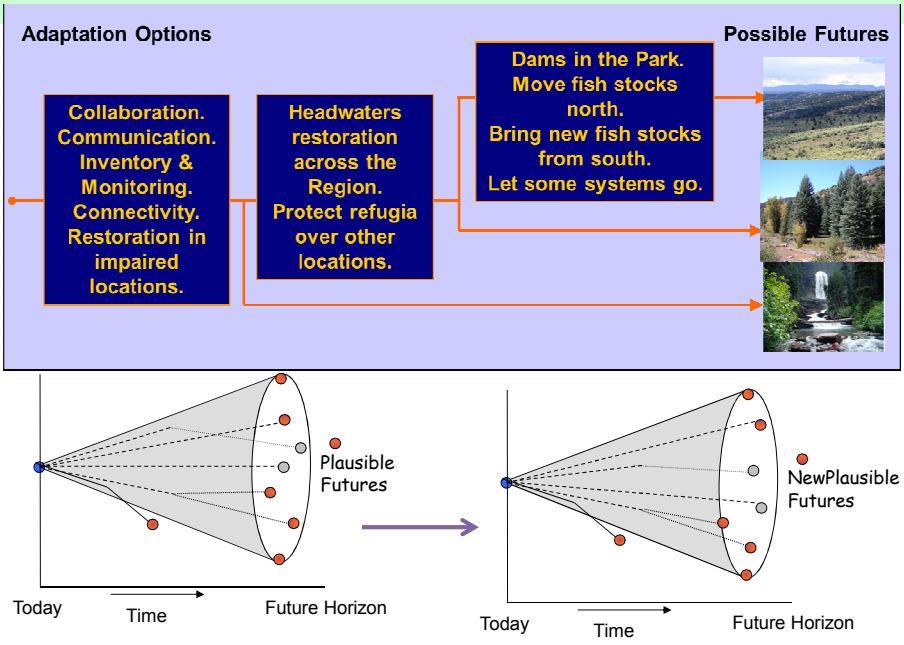
From Caves et al., Ecology and Society, 2013

Rate Collections of Options with Evaluation Criteria



NPS Analogs? Manage for biodiversity, wilderness, scenery, recreation, carbon and water storage

Re-starting the Scenario Planning Process



Identify Options, Timelines, and Decision Points

Objective: develop management options with links to monitoring, research, planning

For a single scenario: work backwards in time

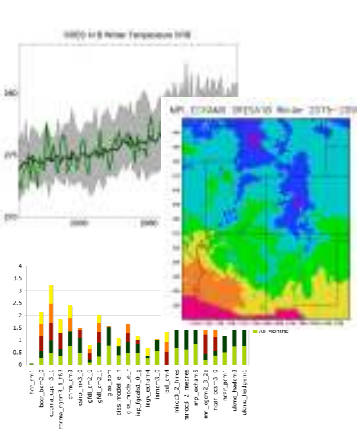
- Perspective 1: Manager in 2100. What do you wish had been put into place in 2050?
- 2: Manager in 2050, end of career. What do you wish you had known/done at the start of your career in 2020

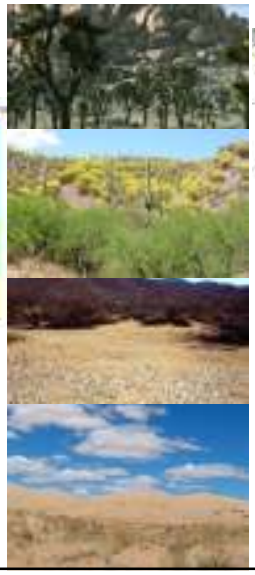
Activity

1. Describe action
2. Create timeline: implementation, impact persistence, preparation time (planning, construction, etc.)
3. Identify decision triggers: hard, soft

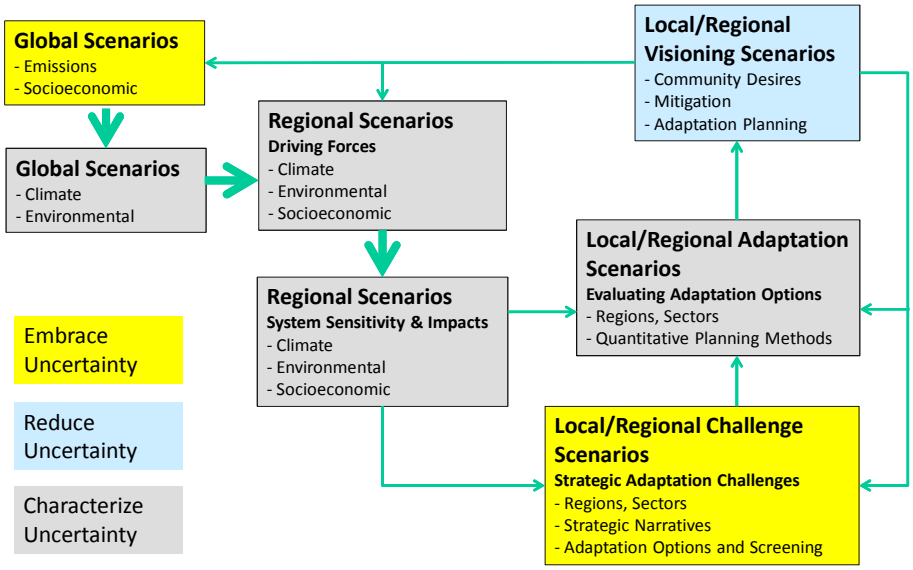
Using Scenarios in Planning: Different Conceptions

Characterizing Uncertainty | Embracing Uncertainty | Reducing Uncertainty

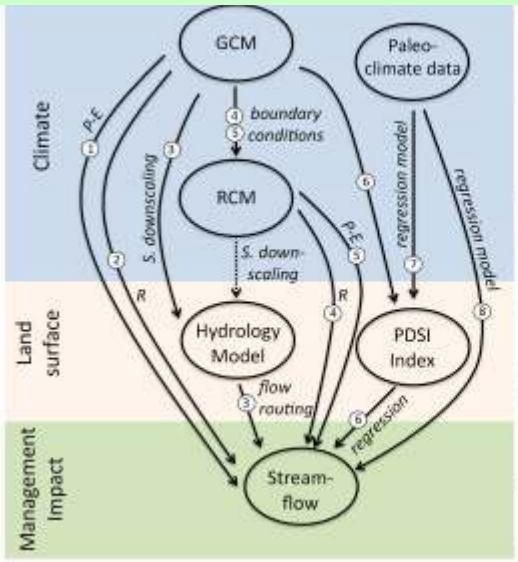




Ecology of Scenarios



Geneology of Projection-based Scenarios



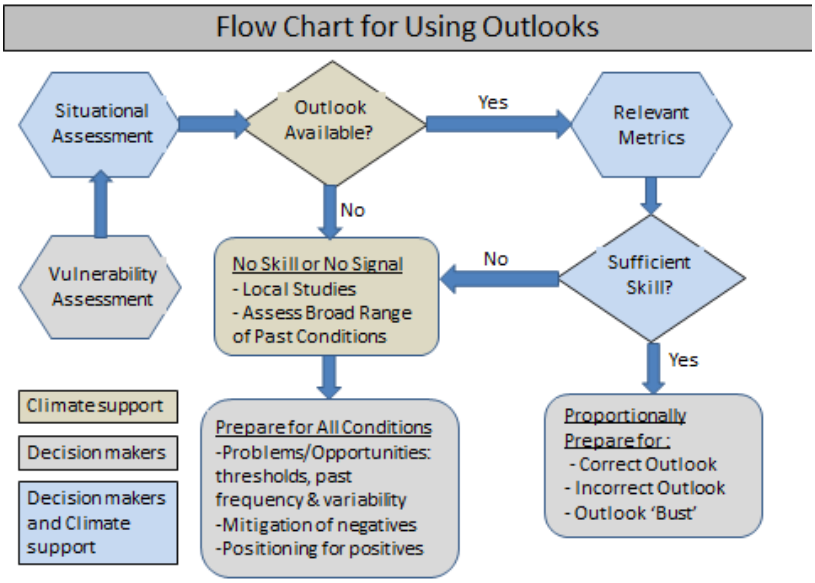
Studies using various approaches:

1. Seager et al. 2007; Seager et al. 2013
2. Milly et al. 2005
3. Christensen et al. 2004; Christensen and Lettenmaier, 2007; Cayan et al. 2010; USBR 2011
4. Gao et al. 2011; Rasmussen et al. 2011
5. Gao et al. 2012
6. Hoerling and Eischeid 2007
7. Cook et al. 2004
8. Woodhouse et al. 2006; McCabe and Wolock 2007; Meko et al. 2007; USBR 2011

Abbreviations:
GCM – Global Climate Model
RCM – Regional Climate Model
PDSI – Palmer Drought Severity Index
P – Precipitation
T – Temperature
R – Runoff
E – Evaporation
S. downscaling – statistical downscaling

From Vano el al., BAMS, 2013

Institutional Learning – Practice with NWS Seasonal Climate Outlooks



Ecology of Scenarios